California Environmental Protection Agency
Air Resources Board

Fact Sheet
March 2008

Dry Cleaning
Alternative Solvents: Health and Environmental Impacts

In January, 2007, the California Air Resources Board (ARB) amended its regulations addressing perchloroethlylene (Perc) emissions from dry cleaning operations. These amendments are effective as of December 27, 2007, and include:

- **January 1, 2008:** No new sale or lease of Perc machines;
- **July 1, 2010:** All Perc machines at co-residential facilities must be removed;
- **July 1, 2010:** Perc machines 15 years and older may no longer be used;
- **January 1, 2023**: Perc machines may no longer be used.

The ARB determined that the benefits from dry cleaning alternatives outweigh the negative health and environmental impacts from the use of Perc.

Questions have been raised about potential health impacts of alternatives to Perc. We offer this fact sheet to describe the available alternative solvents and provide current information on their health and environmental impacts.

The alternative solvents listed are either already in use or are being considered for use in California. This information is not meant to be exhaustive as other solvents may also be available.

Approved Non-toxic and Non-smog-forming Dry Cleaning Technologies

These systems qualify for grant money under California's Non-Toxic Dry Cleaning Incentive Program, established by Assembly Bill (AB) 998.

Water-Based Cleaning

Water-based cleaning systems use water and detergents to clean garments. Currently, there are three types available: 1) professional wet cleaning systems; 2) cold water cleaning systems; and, 3) Green Jet™ dry-wet cleaning™ systems.

- *Health and Environmental Impacts*

  Most detergents used in wet cleaning are a complex mixture of water and chemicals. Because there are a wide variety of formulations, it can be difficult to determine the toxicity of specific products. In general, detergents are approved for disposal into sewer systems by local sanitation districts. The United States Environmental Protection Agency examined the human health and environmental hazards of the primary components of detergents and found no expected health risks to the general public.

Carbon Dioxide (CO_2)

The CO_2 process, developed by commercial and retail dry cleaners, is a high pressure system using liquid CO_2 as the cleaning solvent.

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  CO_2 is a non-flammable, non-toxic, naturally-occurring gas that becomes a liquid solvent when subjected to pressure. There is no expected health risk to the general public from these processes. Questions have been raised because CO_2 is a greenhouse gas which contributes to global warming. Although the amount of emissions from dry cleaning processes have not been studied, the CO_2 used in the dry cleaning processes is a by-product from industrial operations and therefore does not contribute to the greenhouse gas inventory.

Financial Assistance

Financial assistance is available for water-based and CO_2 cleaning systems through the AB 998 Non-Toxic Dry Cleaning Incentive Program. This program provides $10,000 grants to dry cleaners that choose to replace their Perc dry cleaning system with a non-toxic and non-smog forming system. Currently, only water-based and CO_2 cleaning systems qualify as approved technologies. A statewide demonstration program was also established to showcase these qualifying technologies, and to provide an opportunity to educate business owners of the benefits, costs, and effectiveness of these alternatives. More information can be found at http://www.arb.ca.gov/toxics/dryclean/ab998.htm.

In addition to ARB's Non-Toxic Dry Cleaning Incentive Program, some local air districts offer incentives for water-base and CO_2 cleaning systems. A list of the local air districts' contact information can be found on the following website: http://www.arb.ca.gov/capcoa/roster.htm.

Other Available Dry Cleaning Technologies

The following systems are currently being used or being considered for use in California as alternatives to Perc machines.

Hydrocarbon Solvents

Currently, the types of hydrocarbon solvent technologies available are: 1) DF-2000™ Fluid; 2) PureDry®; 3) EcoSolv®; 4) Shell Sol 140 HT; and, 5) Stoddard solvent. The machines predominately used for hydrocarbon solvents are closed-loop machines equipped with primary controls. Detailed information on each of the hydrocarbons is available in the Air Resources Board staff report available at http://www.arb.ca.gov/regact/2007/perc07/perc07.htm .

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  There is limited health information on these hydrocarbon mixtures with the exception of the Stoddard solvent. None of the hydrocarbon solvents have undergone formal evaluation by California for identification as toxic air contaminants (TAC). A two-year inhalation study of Stoddard solvent conducted by the National Toxicology Program (NTP) concluded that there was some evidence of carcinogenic activity in male rats. Additionally, Stoddard solvent can be irritating to the eyes, nose, throat, and can also have effects on the nervous system. A detrimental and secondary health effect of the alternative solvents is that all hydrocarbon solvents are considered volatile organic compounds (VOC). VOCs contribute to the formation of ozone which is linked to many ill-health effects including respiratory irritation, asthma, and premature death.

GreenEarth® (Volatile Methyl Siloxane)

Decamethylcyclopentasiloxane (D_5) or volatile methyl siloxane is an odorless, colorless liquid that has many consumer and industrial applications. D_5 is the ingredient present in the GreenEarth® dry cleaning solvent used in multi-solvent machines. The ARB does not consider D_5 to be a VOC.

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  California's Office of Environmental Health Hazard Assessment (OEHHA) recently conducted an evaluation of the available D_5 information and concluded that exposures of D_5 at the highest achievable vapor concentrations cause uterine tumors in rats. OEHHA is also concerned about the potential non-carcinogenic effects associated with D_5 and its apparent persistence in the environment and animal and human tissues. However, available exposure information indicates that the use of D_5 as an alternative dry cleaning solvent will not pose a risk to the public living near businesses using D_5. D_5 has not undergone formal evaluation for identification as a TAC.

Rynex™ (Rynex 3 or Propylene Glycol Ether)

Rynex™ (Rynex 3) is an organic and biodegradable solvent with low volatility and a high flash point. It is considered a VOC. Rynex 3 can be used in most hydrocarbon machines with some temperature and timing adjustments.

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  Rynex 3 consists of a mixture of glycol ethers. This solvent brand has changed formulation since its inception. Based on a recent study by NTP on the glycol ether ingredient of a previous formulation for Rynex™, propylene glycol t-butyl ether (PGtBE), OEHHA has expressed concerns over its toxicity and carcinogenic potential. Of particular concern, was the presence of tumors in mice. More detailed information on the toxicological studies for the previous formulation of Rynex™ can be found in the Technical Assessment Report. Rynex 3 represents the current formulation for Rynex™, which does not contain PGtBE but instead contains dipropylene glycol tert-butyl ether (DPTB). Currently, there is limited toxicity data available for DPTB. It has not undergone formal evaluation for identification as a TAC.

Limited Use Dry Cleaning Technologies

1-Bromopropane (n-propyl bromide)

1-Bromopropane (n-propyl bromide or n-PB or DrySolv) is an emerging technology which is currently being used outside of California. It is considered a VOC. Although this solvent is being used in modified perchloroethlylene-dry-cleaning machines with secondary control, industry representatives are concerned that n-propyl bromide's inherent properties may lead to more leaks and emissions in such machines.

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  According to the California Department of Health Services, this solvent is a neurotoxicant and reproductive toxicant and is listed under Proposition 65 as a reproductive toxicant. It causes sterility in both male and female test animals, and harms developing fetuses. It can damage nerves, causing weakness, pain, numbness, and paralysis. 1-Bromopropane has a strong odor and is a more volatile compound than Perc, thus increasing its potential for nuisance problems and exposure to near-by residents. This compound has not undergone formal evaluation for identification as a TAC.

Solvair™ (dipropylene glycol normal butyl ether/ CO_2)

Solvair is a recently available commercial dry cleaning technology. The Solvair equipment uses a closed loop process in which dipropylene glycol n-butyl ether (DPNB) is used as the base cleaning and liquid CO_2 is used to rinse out the solvent and dry the garments.

- *Health and Environmental Impacts*

  DPNB is a type of propylene glycol ether. Currently, there is limited toxicity information available for DPNB. It has not undergone formal evaluation for identification as a TAC. There is no expected health risk from the exposure to the CO_2 used in the Solvair technology.

Fire Hazard Considerations

The alternative dry cleaning technologies listed in this fact sheet, with the exception of water-based and CO_2 cleaning technologies use solvents that may be regulated by local Certified Unified Program Agencies (CUPA) because of their flammability and/or combustibility. CUPA contact information may be found on the following website: http://www.calepa.ca.gov/CUPA/Directory/default.aspx.

More information

More information on the alternative technologies may also be obtained from the following website: www.arb.ca.gov/toxics/dryclean/dryclean.htm. This website contains regulatory information and formal rulemaking documents. For more information on the status and requirements of the amended Dry Cleaning Air Toxic Control Measure, please contact one of the following Air Resources Board staff.

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Alternately, you may email questions to dryclean@arb.ca.gov.